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**(FOUO 3/79)**

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10 January 1979

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY  
BIOMEDICAL AND BEHAVIORAL SCIENCES  
(FOUO 3/79)

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### BIOMEDICAL AND BEHAVIORAL SCIENCES

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GENETICS

UDC: 575.577.15.08

LAMBDA-T4 RECOMBINANTS CARRYING GENES 46, 45, 44 AND 62 OF BACTERIOPHAGE T4

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 242, No 6, 1978 pp 1411-1414

[Article by V. I. Tanyashin, G. G. Prytysyuk, V. Ye. Zinkevich and Academician A. A. Bayev, Institute of Biochemistry and Physiology of Microorganisms, USSR Academy of Sciences, Pushchino, Moscow Oblast, submitted 28 Jun 78]

[Text] In our previous works, we demonstrated the possibility of fragmentation of T4 phage DNA by EcoRI endonucleases [1], and we also obtained several  $\lambda$ -T4 recombinants with early and late genes of T4 bacteriophage [2]. This study deals with the characteristics of recombinants carrying a group of early genes 46, 45, 44 and 62.

It is known that nuclease is the product of gene 46 and that it is essential to genetic recombination [3]; the product of gene 45 is required for replication [4] and transcription [5], and the complex of 44/62 proteins is needed for replication of T4 phage [4]. The protein 44/62 complex has DNA-dependent ATPase activity, while the product of gene 45 stimulates the latter [6].

The ease with which the cloned EcoRI fragment of T4 phage DNA is isolated, as well as its fixed position in relation to the well-studied markers of  $\lambda$  bacteriophage, makes it possible to investigate the fine physical structure of phage T4 genes with the use of restriction endonucleases. The use of data on physical mapping enables us to define the orientation of the inserted DNA fragment, and it also makes it possible to isolate individual cistrons from the cloned group of genes.

It has now been established that several proteins of E. coli, such as polynucleotide ligase, DNA polymerase, may be obtained in quantities that are greater by a factor of  $10^2$  than those obtained with the use of the ordinary sources of isolation thereof [7, 8] by means of  $\lambda$ -E. coli recombinants obtained in vitro.

Consequently, it was interesting to determine whether the proteins of T4 phage are synthesized in the foreign environment of  $\lambda$  phage, and whether they retain their functional activity. The obtained recombinants would be of particular value if we were able to augment production of T4 phage proteins as a result of transcription from effective promoters of  $\lambda$  phage, and

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first of all from the powerful left promoter  $P_L$ . In this case, the  $\lambda$ -T4 recombinants could be used to obtain biologically pure (as a result of cloning a specific group of genes) products of T4 phage.

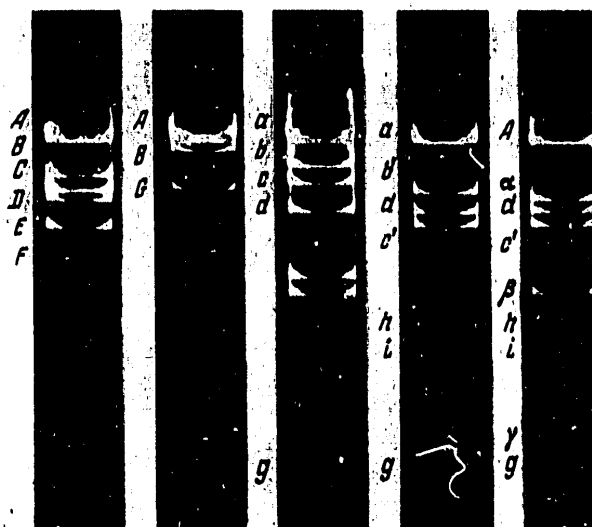


Figure 1. Electrophoretic separation of fragments of DNA of  $\lambda$ cI857 and  $\lambda$ 596-8 phages

- 1) hydrolysis of  $\lambda$ cI857 phage DNA by EcoRI endonuclease
- 2) hydrolysis of  $\lambda$ 596-8 phage DNA by EcoRI endonuclease
- 3) hydrolysis of  $\lambda$ cI857 phage DNA by HindIII endonuclease
- 4) hydrolysis of  $\lambda$ 596-8 phage DNA by HindIII endonuclease
- 5) combined hydrolysis of  $\lambda$ 596-8 phage DNA by EcoRI and HindIII endonucleases

The following were used as markers of molecular weights: A-F, EcoRI fragments of  $\lambda$ cI857 phage DNA [13] and  $\alpha$ -g, HindIII fragments of  $\lambda$ cI857 phage DNA [14]. The molecular weights of HindIII fragments  $h$  (1.0 megadalton) and  $i$  (0.8 megadalton), and Eco RI-HindIII fragments  $\beta$  (1.4 megadalton) and  $\gamma$  (0.4 megadalton) of cloned fragment G of T4 phage DNA were determined from the calibration curve.

Recombinants  $\lambda$ 596-7,  $\lambda$ 596-8 and  $\lambda$ 596-20 [2] were cultivated on E. coli C600 cells and purified in a CsCl density gradient [2]. DNA was isolated by the phenol method [2]. The DNA of recombinants was hydrolyzed with EcoRI, HindIII, SmaI, BamHI endonucleases. In the case of hydrolysis with EcoRI endonuclease, the DNA of all phages presented a fragment of 3.7 megadalton (~5600 nucleotide pairs). SmaI and BamHI did not yield splitting in the region of the T4 phage DNA fragment, and for this reason could not be used to

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determine the orientation of the fragment. In the case of hydrolysis by HindIII endonuclease, three restriction points were demonstrated in the DNA fragment of T4 phage, and the DNA of all three phages presented identical hydrolysis; consequently, all three presented the same orientation of the fragment. In order to localize the sites of HindIII restriction, we used the DNA of  $\lambda$ 596-8 phage. Figure 1 illustrates separation of DNA fragments formed upon complete hydrolysis by EcoRI endonuclease (2), complete hydrolysis by HindIII endonuclease (4) and joint hydrolysis by EcoRI and HindIII (5).

Electrophoresis in agarose gel was performed as previously described. As a result of cleavage of the EcoRI fragment G by HindIII enzyme, there is formation of HindIII fragments *h* and *i* (Figure 1, 4). In the case of treatment of  $\lambda$ 596-8 phage DNA with both EcoRI and HindIII restrictases, in addition to fragments *h* and *i*, fragments of combined hydrolysis  $\beta$  and  $\gamma$  are demonstrable (Figure 1, 5). These results, as well as the results of incomplete hydrolysis by HindIII endonuclease and a mixture of HindIII and EcoRI endonucleases, make it possible to unequivocally map the sites of HindIII in the cloned DNA fragment of T4 phage as illustrated in Figure 2. In this figure, in addition to the diagram showing the location of restriction sites on  $\lambda$ 596-8 phage DNA, are illustrated analogous data for DNA of phages  $\lambda$ cI857,  $\lambda$ 430,  $\lambda$ 596 and  $\lambda$ 596-35 [2], which we used as a control.

It was of considerable interest to determine whether the genes of T4 phage are expressed in the genetic environment of  $\lambda$  bacteriophage and, if so, from which promoter,  $\lambda$  or T4, they are transcribed. It is known that the molecular weights of the products of genes 46, 45, 44 and 62 constituted ~70,000, 27,000, 35,000 and 17,000 dalton, respectively. Consequently, a DNA fragment 4000 base pairs in length is sufficient for coding all these proteins. Having a cloned fragment 5600 base pairs in length, we could have expected that both end genes (46 and 62), or at least one of them, are present in the form of a complete copy.

Demonstration of protein products that did not differ in molecular weight from the proteins coded by T4<sup>+</sup> phage could be evidence of the presence of a complete terminal gene. The proteins synthesized by  $\lambda$ -T4 recombinants, T4<sup>+</sup>, T4amE10 (gene 45), T4amE1140 (gene 62), T4amN82 (gene 44) and T4amN94 (gene 46) phages were studied in cells of *E. coli* 159 gal, uvr, su<sup>-</sup>, which were cultivated on synthetic medium [9] containing 0.4% maltose and vitamin B<sub>1</sub> in a concentration of 1  $\mu$ g/ml. The cells, in a concentration of  $2 \cdot 10^8$ , were cooled, precipitated by centrifugation and resuspended in a concentration of  $1 \cdot 10^9$  cells/ml; 4 ml suspension was placed in a Petri dish and exposed to ultraviolet light for 10 min while stirring it continuously. Infection was produced with a multiplicity of 10. After 3 min, we added to each specimen 10  $\mu$ Ci <sup>35</sup>S-methionine, diluted it 5-fold in warm medium and transferred it to the incubator at 37°C. Infection with  $\lambda$ -T4 recombinants was performed for 20 and 40 min, and with T4 phages for 12 min; the culture was cooled, the cells precipitated by centrifugation, eluted once in a tris-HCl buffer (50 mM), pH 7.8, and stored in a frozen state at -20°C. The infected cells were suspended in 100  $\mu$ l buffer containing sodium

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dodecylsulfate (SDS) and heated for 2 min at 90°C. Electrophoresis of proteins was conducted in sheets of polyacrylamide gel with a gradient of 10-18% acrylamide concentration in the presence of 0.1% SDS [10], at room temperature and 250 V, for 2.5 h. We used RM-1 film for autoradiography. Ox serum albumin (67,000), catalase (60,000), egg albumin (45,000), chymotrypsinogen (25,700) and cytochrome C (12,400) were used as markers to plot the calibration curve [11].

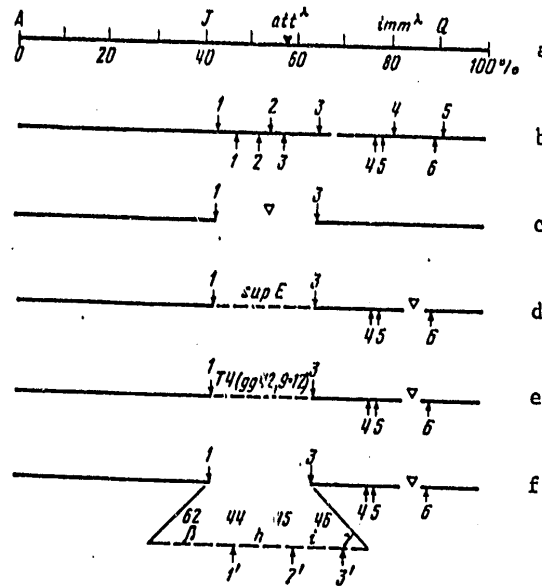


Figure 2. Genetic structure of  $\lambda$  vectors and  $\lambda$ -T4 recombinants used in this study. The top arrows in b-f refer to restriction sites for EcoRI and the bottom ones, for HindIII

- a) genetic map of  $\lambda$  bacteriophage
- b)  $\lambda$  CI857 phage
- c)  $\lambda$  430 phage (phage XI according to [15]). In this phage, the fragment of DNA between EcoRI-1 and EcoRI-3 sites is deleted
- d) vector  $\lambda$  296. The DNA fragment of  $\lambda$  phage between the EcoRI-1 and EcoRI-3 sites is replaced by a DNA fragment of *E. coli* containing gene *supE*
- e) recombinant  $\lambda$  596-35, formed by replacement of the fragment with gene *supE* with DNA fragments of T4 phage with genes 42, 9, 10, 11, 12
- f) recombinant  $\lambda$  596-8, formed by replacement of fragment with gene *supE* with the DNA fragment of T4 phage with genes 46, 45, 44 and 62 [2]

Figure 3 illustrates the results of the experiment dealing with electrophoretic separation of proteins synthesized after infection with  $\lambda$  596-8 phage and

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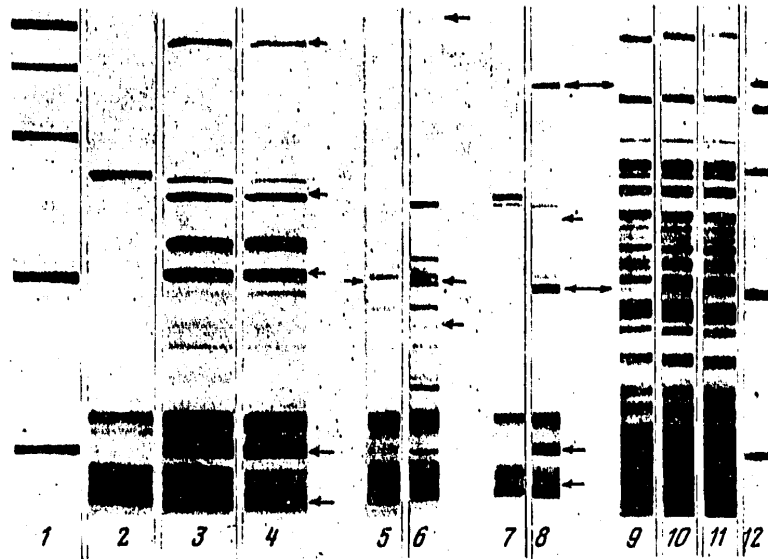


Figure 3. Autoradiogram of proteins synthesized in ultraviolet-irradiated *E. coli* 159 cells infected with different phages

- |  |  |
|--|--|
| 1) standard proteins with molecular weights (top to bottom) of 67,000, 60,000, 45,000, 27,700 and 12,400 |  |
| 2) infection with $\lambda$ 430 phage for 30 min   |  |
| 3) $\lambda$ 596-8 (40 min)  |  |
| 4) $\lambda$ 596-8 (20 min)  | 10) T4B <sup>+</sup> (12 min)  |
| 5) $\lambda$ 596-35 (10 min)   | 11) T4amN94, 46th gene (12 min)  |
| 6) $\lambda$ 596-35 (40 min)   | 12) standard proteins with molecular weights (top to bottom) of 67,000, 60,000, 45,000, 25,700 and 12,400. |
| 7) $\lambda$ 430 (40 min)  |  |
| 8) $\lambda$ 596-8 (40 min)  |  |
| 9) T4amE10, 45th gene (12 min)   | Arrows show position of studied proteins.  |

control phages. For the study of expression of T4 phage genes,  $\lambda$ 596 phage would have been the ideal control; it contains no DNA fragment between EcoRI-1 and EcoRI-3 sites (Figure 2); however, such phage cannot exist in the form of infective particles, since there is not enough DNA, as a result of deletion of *ninR5*, for normal stacking of phage. Phage  $\lambda$ 430 differs from such an ideal phage in that there is no *ninR5* deletion. Figure 3, 8 and 7, shows that  $\lambda$ 596-8 and  $\lambda$ 430 have a considerable number of bands in common. Moreover,  $\lambda$ 430 synthesizes two proteins that are not synthesized by either  $\lambda$ 596-8 or the other control phage  $\lambda$ 596-35, which contains a DNA fragment of T4 phage (genes 42, 9, 10, 11, 12) between the EcoRI-1 and EcoRI-3 sites (Figure 3, 5 and 6) [2]. Phage  $\lambda$ 596-8 codes the synthesis

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of 5 proteins with molecular weights of ~65,000, 39,000, 27,000, 13,000 and 10,000, while  $\lambda$ 596-35 phage codes synthesis of 4 (100,000, 28,000, 26,000 and 24,000) that are absent after infection with  $\lambda$ 430 phage. It was demonstrated that proteins with molecular weights of 65,000 and 27,000 of  $\lambda$ 596-8 phage are completely identical to the proteins synthesized after infecting E. coli cells with T4<sup>+</sup> phage (Figure 3, 10) and absent in genes 45 (Figure 3, 9) and 46 (Figure 3, 11) after infection with amber mutants. Figure 3 also clearly illustrates increased expression of genes 45 and 46 after infection with  $\lambda$ 596-8 phage, as compared to infection with T4<sup>+</sup> phage. Synthesis of these proteins reaches a higher level by the 40th postinfection minute (Figure 3, 2 and 3).

After infecting E. coli 159 cells ( $\lambda$ ind<sup>-</sup>) that had been exposed to ultraviolet light with  $\lambda$ 596-8 phage, the level of synthesis of products of genes 45 and 46 is much lower (data are not submitted). This serves as evidence of the fact that their synthesis is controlled or related to transcription from one or more promoters of  $\lambda$  phage, and it also indicates that the promoter (or promoters) of T4 phage contained in recombinant  $\lambda$ 596-8 is either not recognized at all by E. coli RNA polymerase, or else is weaker than the promoters of  $\lambda$  phage [12].

Our study enabled us to derive the following conclusions: 1) The cloned fragment of T4 phage contains three restriction sites for HindIII endonuclease. 2) Using cloning in HindIII  $\lambda$  vectors, it is possible to isolate the individual genes of the studied DNA fragment of T4 phage. 3)  $\lambda$ 596-8 codes synthesis of the product of gene 46, which does not differ from the analogous protein of T4<sup>+</sup> phage. This means that the recombinant contains a complete copy of gene 46. 4)  $\lambda$ 596-8 codes synthesis of the product of gene 45, with a molecular weight of 27,000, that does not differ in molecular weight from the corresponding protein synthesized by T4 phage. 5) Both proteins are synthesized by recombinant  $\lambda$ 596-8 in quantities that are appreciably greater than those obtained after infection with wild type T4 phage.

The authors wish to express their appreciation to Dr Norin Murray for strain  $\lambda$ 430, Dr Michelin Gifart-Gassler for E. coli strains 150 and 159( $\lambda$ ind<sup>-</sup>), N. P. Kuz'min for providing BamHI endonuclease and to N. A. Matveyeva for her technical assistance in our work.

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MARINE MAMMALS

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KINEMATIC CHARACTERISTICS OF SWIMMING IN CERTAIN AQUATIC ANIMALS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA MEKHANIKA ZHIDKOSTI I GAZA  
in Russian No 5, 1978 pp 3-9

[Article by V. P. Kayan, L. F. Kozlov and V. Ye. Pyatetskiy, Kiev]

[Text] Data on the speed and kinematics of swimming of various fish and cetaceans are of substantial practical interest in connection with the fishing industry and may also be used in establishing hydrodynamic theories of swimming.

Presented below are experimental data on the kinematics and swimming speed of several types of fish and cetaceans of the afalina [Tursiops truncatus Montagu] type. Studies with aquatic animals were made at the Institute of Hydromechanics of the UkSSR Academy of Sciences in units especially designed and constructed for this purpose--biohydrodynamic tunnels [1, 2], a circular biohydrodynamic unit and a coastal hydrodynamic canal [3].

Fish that use undulating movements of the body as the method of swimming are divided into three groups [4]: with an eel-like method of movement (there are locomotor oscillations approximately equal in amplitude along the entire length of the body), with a scombroid method (the amplitude of the locomotor oscillations increases from the nose to the tail according to a definite law) and with the "trunkfish" method (only the rigid caudal fin carries the locomotor function and the torso is immobile). Examples of two of the methods of motion were studied: eel-like--garfish, and scombroid--bluefish, mullet, bonito and trout. A description of the method of performing the experiment and the equipment used, making it possible to record the elements of the kinematics of the fish being studied, is given in [5-7].

In the biohydrodynamic tunnels [1, 2], experiments were performed during the counter motion of the fish, using the optomotor reaction appearing in them as a reflex. The essence of this reaction is that of involuntary tracking of a moving reference point by the eye and the entire body of the fish. In the case being discussed, the fish swam against the water current and, in heading for a reference grid on the bottom of the working part of the tunnel, remained seemingly "immobile" with respect to the tunnel itself and to the

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observer. In the circular unit [3], a white screen with dark vertical stripes moving in a circle from the outer side of the circular canal served as the reference point.

When analyzing the material obtained for statistical processing, only the behavior regimens were selected in which no movements of the fish along the long axis of the working section were observed. In these cases the speed of the fish was constant and equal to the rate of flow at the given point of the cross section of the working part of the tunnel. Because of the fact that the profile of the speeds in the working section changed substantially near the walls (up to 10 percent), the behavior regimen when the fish being studied was near the wall were rejected. Despite the fact that the level of turbulence in the tunnel was quite substantial, the results obtained coincide well with the data from work [8], obtained for it in a so-called "fish wheel," where the level of turbulence was negligible, as well as with the results when the fish swam at low speeds in a circular biohydrodynamic unit, where the water was not moving. Therefore, the level of turbulence in the fluid obviously has little effect on the values of the kinematic parameters of the movement of aquatic animals.

The coastal hydrodynamic canal in which experimental studies were made with cetaceans of the afalina type was 65 meters long and had a square cross section of 4 square meters. In the middle part of the canal, in a section 11 meters long, one of the side walls was made of glass. In order to record the position of the subject of the studies at various moments in its passage through the "working" section, on the opposite wall of the canal, black against a white background, a reference grid with the units measuring 0.5 X 0.5 meters was drawn.

The elements of the kinematics of the swimming of the aquatic animals being studied were recorded by a movie camera. In this case two Konvas-Avtomat type cameras were used. The filming was done on black and white negative film 35 mm wide with the frame measuring 16 X 22 mm. Selected for subsequent processing from the experimental material obtained on the cetaceans' swimming were those behavior regimens in which the afalina's center of gravity shifted horizontally close to the long axis of the canal.

In order to increase the time-reading accuracy, in the subsequent interpreting of the frames, in the process of filming, an electric second timer was placed in front of the glass working part within the contact angle of the movie camera's objective. The regimens selected were processed graphically and statistically by means of a Mikrofot-5 PO-1 interpreter. In it, the picture from each frame was projected on a diffusing-reflecting screen measuring 360 X 300 mm.

For each experimental animal, at each instant, the amplitude  $A_0$  of the oscillations of the posterior edge of the caudal fin was determined, and for each operation the relation  $A_0(t)$  was constructed. The period  $T$  and frequency  $f$  of the oscillations of the caudal fin of the fish were also determined from these same graphs.

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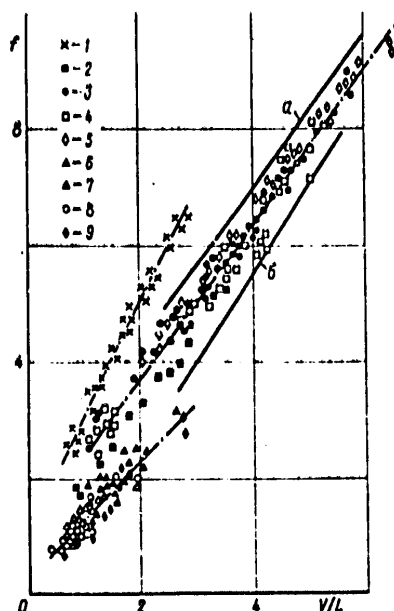


Figure 1.

The average values for the regimen of the frequency  $f$  and the amplitude  $A_0$  were determined by methods of mathematical statistics in tabular form in accordance with the system of processing equal-point measurements [9]. For all the fish the average root-mean-square deviation in determining the amplitude of the oscillations of the caudal fin was 5-7 percent and of the frequency--4-5 percent.

Since the forward movement of the afalina-type cetaceans is distinguished by its nonstationary nature, the values of  $A_0$  and  $T$  for them were determined as the average oscillations of the caudal fin for the period. At each instant their forward speed  $V_A$  was determined, and a graph of its changes in time  $V_A(t)$  was plotted. The average speed of the afalina for the given period of oscillations of the caudal fin, as well as the value and sign of the changes in speed were determined according to this graph. The average root-mean-square deviation of these values in all cases did not exceed 4-5 percent.

The relation of the frequency of oscillations  $f$  of the caudal fin of all the aquatic animals studied to the relative speed of their swimming  $V/L$  is shown in Figure 1 (1--garfish,  $L = 0.4-0.48$  meters; 2--bluefish,  $L = 0.42$  meters; 3--mullet,  $L = 0.24-0.3$  meters; 4--trout,  $L = 0.2-0.22$  meters; 5--bonito,  $L = 0.16$  meters; 6--cetaceans,  $L = 2.35-2.65$  meters, with the acceleration of the movement  $V = +(0.35-1.5)$  m/sec<sup>2</sup>; 7-- $V = +(0.1-0.3)$  m/sec<sup>2</sup>;

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8--  $V = (0 \pm 0.07) \text{ m/sec}^2$ ; 9--  $V = -(0.1-0.3) \text{ m/sec}^2$ ). Experimental points 1-9 on the graph  $f(V/L)$  were clearly divided into three groups, each of which belongs to aquatic animals with a certain method of swimming.

Through points 1, characterizing the frequency of the locomotor oscillations of the body of examples of the eel-like method of movement--the garfish--a straight line can be drawn which, with the values  $V/L \geq 1$ , is described by the equation

$$(1) \quad V/L = a(f-b) [1/\text{cck}], a=0.5, b=1$$

For fish with the scombroid method of movement, through experimental points 2-5, characterizing the frequency of oscillations of the caudal fin of the bluefish, mullet, trout and bonito respectively with different speeds of their swimming, a straight line can also be drawn which, with the values  $V/L > 1$ , is described by equation (1) when  $a = 0.75$ ,  $b = 1$ .

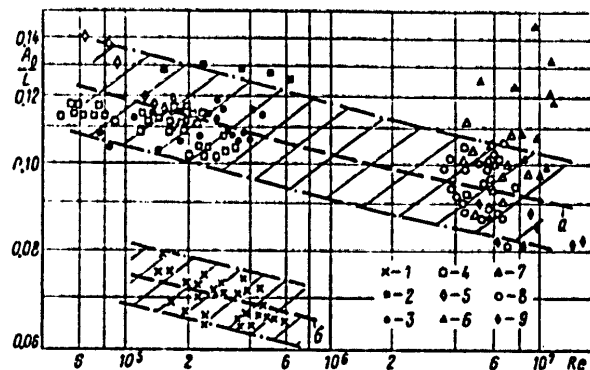


Figure 2.

It should be noted that the empirical equations of the straight lines passing through points 2 and 5, which correspond to the large and small experimental fish, differ somewhat from the latter equation. For example, for the bluefish with a length  $L = 0.42$  meters (points 2), the relation  $V/L(f)$  takes the form (1) when  $a = 0.71$ ,  $b = 0.5$ , and for bonito, with a length of  $L = 0.16$  meters (points 5)  $a = 0.79$ ,  $b = 1.5$ .

Here, however, in Figure 1, for comparison are given the relations  $V/L(f)$  obtained in the circular rotating canal for several types of fish with the scombroid method of movement [8] (straight line  $a$  --equation (1) when  $a=0.75$ ,  $b = 1.33$ ), as well as for the Pacific Ocean tuna [10] (straight line  $b$  when  $a = 0.64$ ,  $b = 0.76$ ). From comparisons of the expressions obtained it follows that to achieve an identical value of relative speed, the fish with the

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eel-like method of movement needs a 1.5-fold greater frequency of locomotor oscillations of the body than does the fish with the scombroid method of movement.

The experimental data obtained in studying the swimming, 6, of the specimen of the afalina type of cetacean [11, 12], are shown in Figure 1 by points 6-9. If the change in the forward speed of the dolphin during the period of the oscillations of its caudal fin is close to zero (points 8), for values  $0.5 < V/L < 2$ , an averaging straight line, described by equation (1) when  $a = 0.95, b = 0.25$ , may be drawn through the points.

Points 6 and 7, characterizing the afalina's swimming with considerable acceleration, are located mainly above this straight line, and points 9 (deceleration in the order of  $0.1-0.3 \text{ m/sec}^2$ )--below it.

In addition to the frequency of oscillations of the caudal fin, the thrust created by the aquatic animal is also affected by the amplitude  $A_0$  or the range  $2A_0$  of the oscillations of the posterior edge of the caudal fin. Figure 2 shows the relation of the relative amplitude  $A_0/L$  of the oscillations of the caudal fin of the fish and cetaceans to the Reynolds number ( $Re = VL/\nu$ , where  $\nu$  is the kinematic coefficient of viscosity, the value of which in our experiments changed from  $0.93$  to  $1.16 \text{ m}^2/\text{sec}$ ). The designations here are the same as in Figure 1.

For fish with the scombroid method of swimming, the value  $A_0/L$  in the range of the numbers  $Re \approx (0.5-5) \cdot 10^5$  has a considerable spread ( $A_0/L = 0.10-0.13$ ), and for a certain type of fish with a change in the swimming speed it varies little. The values obtained of the relative amplitude for afalinas with uniform swimming (points 8) are distributed quite densely in a range of numbers  $Re \approx (3-8) \cdot 10^6$ , where  $A_0/L = 0.08-0.105$ . Through the points obtained for fish with the scombroid method of swimming and the points for the cetaceans, whose method of swimming is similar to the scombroid, an average approximating curve  $a$  can be drawn, which is described by the analytic relation

$$(2) \quad A_0/L = a (\lg Re)^n \quad (a=0.51, n=-0.9)$$

In the shaded areas adjacent to the curve  $a$  and bounded by equidistant dot-and-dash curves, the values  $A_0/L$  which differ from those described by equation (2) by  $\pm 12$  percent, are found the overwhelming majority of experimentally obtained values  $A_0/L$  for aquatic animals with scombroid and similar methods of swimming.

The values  $A_0/L$  for fish with the eel-like method of swimming are distributed in the area bounded by the dot-and-dash curves, which are equidistant to curve  $b$  and differ from it in value by  $\pm 8$  percent. The average approximating curve  $b$  is described by an analytic relation (2) when  $a = 0.32, b = -0.9$ .

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It should also be noted that movement with great acceleration (thrusts, starting from place) in cetaceans is accompanied by considerably higher values of relative amplitude of oscillations of the caudal fin ( $A_0/L = 0.13-0.15$ ), than in uniform swimming.

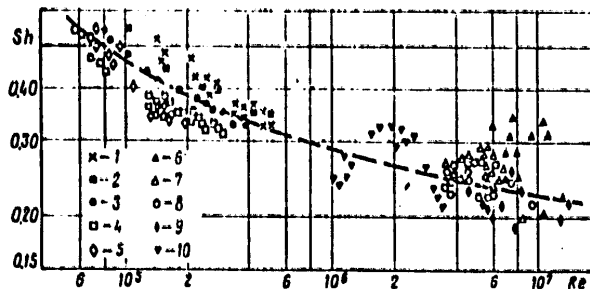


Figure 3.

The relation between the kinematic characteristics of the caudal fin and the speed of swimming and geometric dimensions of the body of the aquatic animal is expressed more fully by the relation  $Sh(Re)$ , where the number  $Sh = Af/V$  is the amplitude-frequency characteristic of the flapping propelling device of the aquatic animal ( $A = 2A_0$  -- the range of oscillations of the posterior edge of the caudal fin). This relation for the fish and cetaceans that we studied is shown in Figure 3. The designations (1-9) are the same as for Figure 1. Points 10 in Figure 3 show the values of the  $Sh$  number, obtained in [13] by a movie camera, of whitesided and Azov type cetaceans with a length of  $L = 1.1-1.6$  meters, in a circular tank.

An average approximated curve may be drawn through all the groups of points obtained experimentally that characterize the amplitude-frequency characteristic of the flapping propelling agent of various aquatic animals during uniform swimming. The equation for this curve takes the form

$$(3) \quad \lg Sh = (5.16 - 1.15 \lg Re) (1.3 \lg Re - 4.7)^{-1}$$

The maximum deviation of the experimental points, with respect to value, from the average curve is not over +20 percent. The empirical equation (3) makes it possible, for certain Reynolds numbers, to determine the optimum value of the amplitude-frequency characteristic of the flapping swimming propelling device.

In order to calculate some of the hydrodynamic characteristics of the swimming of aquatic animals according to the formulas suggested in [14, 15], in addition to the kinematic characteristics of the caudal fin, it is necessary to know the parameters of the locomotor wave, traveling with increasing

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amplitude along the body of the aquatic animal from nose to tail. To determine the length of this wave  $\lambda$  and the ratio of the speeds  $V/c$  ( $c$  is the speed of the traveling locomotor wave, in m/sec), special cinegrams were plotted of the swimming of the fish and dolphins. The extremums of the locomotor wave at one side of the body of the fish were marked by dashes. Then the distance between the two adjacent parallel dash-lines is equal to the length of the locomotor wave  $\lambda$ , and the incline of the dash-line toward the axis of the abscissa determines the value of the ratio of the speeds [6, 7], i.e.

$$(4) \quad V/c = S_1(S_2 - S_3)^{-1}$$

where  $S_1$  is the path traversed by the fish during the time  $\Delta t, m$ ;  $(S_2 - S_3)$  -- the corresponding value for the locomotor wave [6, 7].

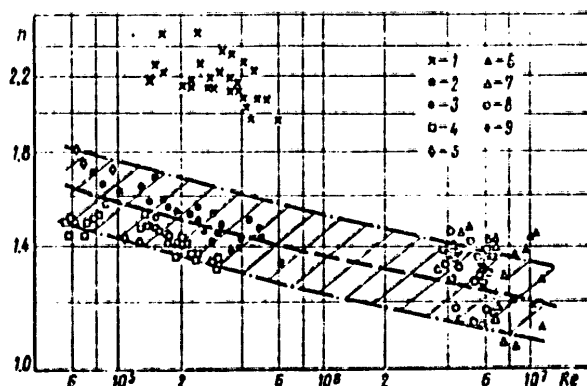


Figure 4

The length of the locomotor wave and the number of these waves that fit in along the body depend on the size, speed and method of swimming of the aquatic animal. Figure 4 shows the change in the relation of the value of the Reynolds number and the swimming method. The designations are the same as in Figure 1. An average approximating curve can be drawn through the experimental points 2-9, obtained for fish with the scombroid swimming method and for dolphins, in the first approximation. This curve is described by the analytical relation

$$(5) \quad n = 6.8(\lg Re)^{-0.9}$$

The overwhelming majority of experimental points obtained lies in the area adjacent to this curve and bounded by the dot-and-dash curves equidistant to it, with a  $\pm 10$  percent difference with respect to the value of the constant coefficient.

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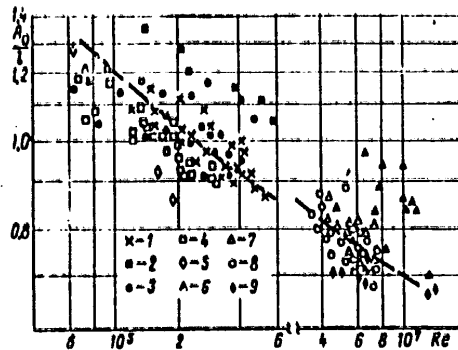


Figure 5.

For fish with an eel-like swimming method, the number of waves fitting in along the body of the fish is approximately 1.5-fold greater than for fish with a scombroid swimming method, with the same Reynolds numbers. In a range of numbers  $Re = (1.5-6) \cdot 10^5$ , for garfish, 2-2.5 locomotor waves are constantly present on the body.

An important dimensionless parameter, necessary to calculate the hydrodynamic characteristics of the swimming of aquatic animals according to the formulas in [14, 15] is the reduced amplitude of the oscillations of the caudal fin  $A_0/L$ , where  $L = \lambda/2\pi$  is the reduced length of the locomotor wave, in meters. The relation of the value  $A_0/L$  to the Reynolds number for different aquatic animals is shown in Figure 5. The designations are the same as in Figure 1.

An average approximating curve may be drawn through the experimental points obtained for all the types of fish studied. In the range of numbers  $Re = (0.6-6) \cdot 10^5$ , it is described by an equation of the type

$$(6) \quad A_0/L = a(\lg Re)^n \quad (a=21, n=-1.8)$$

The maximum deviations of the values  $A_0/L$  obtained experimentally from those determined according to formula (6) do not exceed +15 percent. An average approximating curve may also be drawn through points 8, corresponding to the values  $A_0/L$ , obtained for afalinas with uniform swimming. In the range of the numbers  $Re = (3-8) \cdot 10^6$ , this curve may be described by an equation in the form of (6), when  $a=24, n = -1.8$ .

Therefore, it may be stated that for all the aquatic animals studied, the basic kinematic parameters of the curving-oscillating movements of the body --  $A_0/L$ ,  $A_0/L$  and  $n$  -- depend on the Reynolds number and these relations are described by an equation of the type  $a(\lg Re)^b$ , where  $a$  and  $b$  are the coefficients depending on the type of animal, method of swimming and type of

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kinematic parameter; the relative speed and method of swimming of these animals has an effect on the frequency of the oscillations of the propelling device  $f$ .

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MARINE MAMMALS

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ANESTHETIZING DOLPHINS WITHOUT CUTTING OFF THEIR NATURAL RESPIRATION

Leningrad ZHURNAL EVOLYUTSIONNOY BIOKHIMII I FIZIOLOGII in Russian No 4, 1978 pp 410-411

[Article by R. M. Meshcherskiy; N. V. Menyaylov; I. S. Shepeleva; I. I. Korenev; Yu. A. Toporov; I. A. Gorelov; and I. S. Ivanov, Institute of Psychology of the USSR Academy of Sciences, Moscow, and the Department of Anesthesiology and Resuscitation, Central Institute of Traumatology and Orthopedics imeni N. N. Priorov, Moscow]

[Text] According to established opinion, respiration in dolphins of various species (*Tursiops truncatus*, *Phocoena phocoena* [porpoise], *Lagenorhynchus obliquidens*) is of a purely voluntary nature, and in medication sleep, induced by even small doses of various types of anesthetics, respiration is completely cut off [1-4]. Only Pentothal sodium [5] or halothane [2, 3, 6] are used to anesthetize dolphins, with compulsory use of artificial pulmonary ventilation. The use of succinylcholine, tranquilizers, ether, morphine or nitrous oxide to immobilize and anesthetize dolphins has been acknowledged to be inadequate [2, 3, 5, 7, 8].

On the shore of the Black Sea we conducted a series of tests on anesthetizing clinically healthy dolphins, adapted to the conditions of being kept in a pen (at least one month after capture).

Using Pentothal sodium (with intubation) and then an inhalation anesthetic--pentrane--showed that this type of anesthesia is also unsuitable for working with dolphins. Only in one experiment out of five on *Phocoena phocoena* did the animal emerge from the anesthesia with recovery of respiration and reflexes. Its behavior in the course of the following days did not differ from normal. In another experiment the animal perished when barbiturates were administered. In two experiments with dolphins, after cessation of the anesthesia, a temporary restoration of the respiratory reflex was observed (individual respiratory cycles, opening of the blow hole). Complete normalization of the respiratory action did not occur, however, and the animal died. In two other experiments the animals emerged from the anesthesia and almost complete normalization of the respiratory action and swimming reflexes occurred. Two hours later in both these cases, however, respiratory disorders occurred and the animals died.

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These experiments, as well as the data from a series of experiments made earlier (in general unsuccessful) on the dolphins *Tursiops truncatus* and *Phocoena phocoena*, using ditillium, Pentathol sodium and a number of other preparations for immobilization, permit the conclusion to be drawn that the intubation procedure, cutting off natural respiration and transferring to artificial respiration lead to serious disorders in the coordination of the respiratory action in dolphins, which necessitates the development of special techniques for postanesthetic resuscitation for these animals.

When studying the effect on dolphins of various anesthetics, we selected an anesthetization procedure that would induce a simulated "natural" sleep, sufficiently deep, without cutting off the respiration and disturbing the coordination of the respiratory action. Favorable results were obtained in experiments on two dolphins, *Tursiops truncatus*, each of which was anesthetized twice. In one case surgery was performed during the anesthesia.

The following methodology was used: premedication--atropine (1.0 mg per 50 kg, intravenously) and Seduxen (5.0 mg per 100 kg, intravenously); anesthesia--sodium oxybutyrate (1.0 g per 50 kg intravenously), Droperidol (12.5 mg/100 kg intravenously) and Phentanyl (0.5 mg/100 kg intravenously).

Control over the depth of the anesthesia and the general condition of the animal was implemented through an EKG, eyelid reflex, corneal reflex, Klyap-reflex (contraction of the throat muscles when a foreign body is introduced into the throat), tongue reflex, swimming reflex (tail movement), pectoral fin reflex (to scratching the neck), blow hole reflex and the pain reflex (to pricking the tongue with a needle).

Some 20-30 minutes after administration of these preparations, complete relaxation of the animals, loss of all reflexes and a sharp reduction in pain sensitivity occurred. The respiratory rate was 2-3 cycles per minute, and the rate of cardiac contractions--60-70 per minute. The eyes were closed or half-closed. The depth and duration of the anesthesia was sufficient to perform major operations.

The gradual restoration of the reflexes began 1 1/2 to 2 hours after administration of the preparations. After 3 1/2 hours the animal was placed in a small tank, and then after complete normalization of behavior was let out into the large tank.

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CLASSIFICATION OF NEUROTIC AND PSYCHOPATHIC STATES

Moscow ZHURNAL NEVROPATOLOGII I PSIKHIATRII in Russian No 11, 1978  
pp 1676-1681

[Article by I. A. Burlakov, B. P. Kalachev, and Ye. V. Dobrokhotova,  
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Moscow Medical Institute imeni N. I. Pirogov No 2 and Moscow Psychoneuro-  
logical Hospital No 8 imeni Z. P. Solov'yev]

[Text] The clinical criteria for delimiting psychopathies from other forms of borderline states, including neuroses, were formulated by Gannushkin (1). After the concept of acquired psychopathy (pathological development of the personality) was introduced into psychiatry, it became even more difficult to distinguish psychopathies from neuroses (2). As an example, the possibility for a transition from a neurotic state to pathological development of the personality that clinically resembles psychopathy has been shown (3). In the opinion of G. K. Ushakov there are no fundamental clinical differences between neuroses and psychopathies: There are two-way bridges between neurotic and psychopathic reactions and states, and between the characteristics of their development (4). Korolev (5) describes six signs of a transition to developing neurosis. Thus the problem of delimiting neuroses from psychopathies continues to plague us today (6).

The goal of the present study was to analyze the possibilities for automatically (with the help of a computer) classifying neurotic and psychopathic states and analyzing the most significant anamnestic signs and clinical symptoms that make these states different.

The research was conducted on 358 case histories of persons hospitalized within a 10-year period at the Moscow Psychiatric Hospital imeni Z. P. Solov'yev (in the periods from 1945 to 1950 and from 1956 to 1960 inclusively) for reason of neurotic (with the exception of obsessive neurosis) and psychopathic states. The ages of the patients at the time of their admission were from 16 to 40 years. The case histories of 204 persons for whom we managed to obtain detailed catamnestic information were subjected to final mathematical analysis. Catamnestic surveys were

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performed in 1977: The outpatient charts of Moscow regional polyclinics and psychoneurological dispensaries servicing the zones within which the patients lived were studied. Eighty-three of the patients could not be located, 24 were dropped in view of the absence of complete data, 34 were excluded due to change in the diagnosis to schizophrenia, 4 were dropped due to change in the diagnosis to organic lesion of the central nervous system (one case of oligophrenia and three of specific etiology), 1 was excluded due to diagnosis of obsessive neurosis, and 8 patients died in the period of catamnestic observation (including one death by suicide).

During the time of catamnestic observation the psychopathy diagnosis was changed to a diagnosis of neurosis and vice versa in particular cases. The observation was qualified as a "neurosis" when a psychopathic syndrome failed to reveal itself throughout the entire time of catamnestic observation.

Table 1 shows the distribution of the 204 patients in relation to age and sex.

Table 1. Distribution of Patients in Relation to Sex and Age at the time of Initial Admission

(1) Возраст	Пол (2)		Всего Суммарно (5)
	(3) м.	(4) ж.	
16—20	15	6	21
21—25	15	15	30
26—30	16	19	35
31—35	15	32	47
36—40	13	58	71
Итого (6)	74	130	204

## Key:

- |         |                   |
|---------|-------------------|
| 1. Age  | 4. Female         |
| 2. Sex  | 5. Total patients |
| 3. Male | 6. Total          |

There were almost twice as many women as there were men in our observations, in which case this preponderance was especially obvious in the age group from 31 to 40 years.

The distribution of patients in relation to their diagnoses is shown in Table 2.

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Table 2. Distribution of Patients with Different Types of Psychopathies and Neuroses, in Relation to Sex

(1) Диагноз	Пол (2)		(5) Всего
	(3) м.	(4) ж.	
Психопатия: (6)			
возбудимая (7)	14	19	33
тормозимая (8)	0	0	0
Астеническая и неустойчивая (9)	25	32	57
ананкастическая (10)	5	5	10
шизоидная (11)	1	1	2
истерическая (12)	7	16	23
(5) Итого . . .	52	72	124
Неврозы: (13)			
истерический (12)	1	17	18
неврастения (14)	14	22	36
невротическая депрессия (15)	4	10	14
тревожная депрессия и невроз страха (16)	2	9	11
ипохондрическая (17)	1	0	1
Итого . . . (5)	22	58	80

## Key:

- |                          |  |
|--------------------------|--|
| 1. Diagnosis             | 10. Anancastic                           |
| 2. Sex                   | 11. Schizoid                             |
| 3. Male                  | 12. Hysteric                             |
| 4. Female                | 13. Neuroses:                            |
| 5. Total                 | 14. Neurasthenia                         |
| 6. Psychopathy:          | 15. Neurotic depression                  |
| 7. Excitable             | 16. Anxious depression and neurotic fear |
| 8. Inhibitory            | 17. Hypochondria                         |
| 9. Asthenic and unstable |  |

As we can see from Table 2, observations involving diagnosis of psychopathy were dominated by persons with inhibitory psychopathic characteristics--asthenic and unstable (labile) psychopathies. Neurotic states were encountered predominantly in the form of neurasthenia, and asthenic, asthenoneurotic, and neurotic reactions were included within this group as well.

Anamnestic and clinical data from the case histories were classified with the help of a set of graduated signs and clinical scales (45 characteristics in all) described earlier (7). Table 3 shows the most significant of them, and it indicates the level of significance of differences between neuroses and psychopathies in relation to these characteristics on the basis of the  $\chi^2$  test, using Yates' correction. As we can see from Table 3,

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neuroses and psychopathies differed significantly in relation to a number of characteristics. Just this simple analysis alone (one not accounting for the mutual dependencies of the characteristics) is enough to permit computer classification.

The classification program was written by one of the authors (I. A. Burlakov) for the Minsk-32 computer. The principal method is the Bayes strategy (8). The appropriate parameters were computed in relation to samples (case histories) corresponding to each class (neuroses and psychopathies). This stage was called "computer teaching" (9, 10). "Teaching" was conducted in two stages--"rough" to exclude characteristics providing little information, and final. The information content of the characteristics was assessed by means of a test accounting for Kul'bak's concept of information (11) and Shannon's information theory (12).

The computation results are printed out by the computer in the form of tables of weight coefficients of the signs and the error probabilities (percent of observations wrongly classified by the computer). Figure 1 is a graph of classification errors depending on the complexity of the approximating (approaching the empirical data) mathematical model. In this case the classification errors pertain to observations made in 1958-1960 as a control. Tranquilizers were broadly employed in sanatorium wards during this time. When the entire group of neurotic or psychopathic patients is used as the control, the percent error decreases correspondingly to 6-9. This attests to erasure of clinical differences in response to tranquilizer therapy. In the case where the sum total of signs obtained from case histories was interpreted as a homogeneous group, it was described by the density function of one elementary distribution. Such a group of objects is called a taxon (13). When density functions of a large number of elementary distributions are employed, the existence of a correspondingly larger number of taxons (subgroups of discrete objects) is assumed. As we can see from Figure 1, enlargement of the number of subgroups does not noticeably change the percent classification error.

Figure 2 is a graph of information distances (weight coefficients) of the dominant signs depending on the number of subgroups in the taxons. The higher the weight coefficient, the higher is the information content of the sign. In all taxons the sign "excitable traits in childhood" remains within the group of dominant signs, and beginning with the second taxon it is dramatically delimited. This agrees with both the definition of psychopathy and the data of Table 3, from which we can see that in the presence of psychopathies this sign is encountered with significantly greater frequency (the difference is highly significant).

The information significance of the sign "incomplete family" is of interest. It persists in the group of the six dominant signs in the first, second, fourth, and fifth taxons. At the same time (see Table 3) the frequency with which this sign appears is almost identical in the presence of neuroses and psychopathies. The sign's correlation with others

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Table 3. Significance of Differences Between Neuroses and Psychopathies in Relation to Particular Signs

Index	Signs	Frequency with which sign is revealed, %		P
		In presence of neuroses No 80	In presence of psychopathies No 124	
1	Psychopathy present in the direct line of descendants, and schizophrenia is present in direct and lateral lines	30	44	Insignif.
2	Incomplete family	19	24	"
3	Unfavorable conditions for growing up (spoiled by family, excessive sheltering, lack of supervision, truancy)	35	43	"
4	Fears in childhood (fear of the dark, isolation, certain objects, and death)	4	11	"
5	Other neurotic symptoms in childhood (nocturnal enuresis, nightmares, somnambulism)	12	14	"
6	Inhibitory traits of character in childhood (shyness, noncommunicativeness, anxiety)	20	36	"
7	Asthenic traits in childhood (fatigability, lowered resistance)	31	45	0.05
8	Excitable traits in childhood (naughtiness, stubbornness, outbursts of excitability, sense of oppression, running away)	15	45	0.001
9	Hyposocial traits of character (weak emotional control, carelessness, low moral criteria, inability to plan behavior)	8	20	0.05

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Table 3.

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10	Hysterical traits of character (sthenia, an inclination for the unusual and brilliant, tendency toward fantasizing, inconstancy, parasitical tendencies)	21	33	Insignif.
11	Excitable traits of character (irritability, straightforwardness, propensity for conflict, outbursts of anger and rage)	49	81	0.001
12	Duration of illness* by moment of evaluation (that is, admission to the hospital) not greater than 3 years	36	56	0.01
13	Attacks of panic fear	30	15	0.05
14	Pronounced anxiety symptoms	56	68	
15	Suicidal tendencier (statements, threats, attempts)	24	39	0.05
16	Dysthymia (querulousness, sullenness, difficultly controlled and uncontrollable outbursts of coarse behavior)	40	74	0.001
17	Obsessive-compulsiv: symptoms (importunity, obsessive thoughts and actions)	24	35	Insignif.
18	Hysterical symptoms (tremor of eyelids, tongue or hands, attacks of tremor within the chest and over the entire body, passing aphonia, mutism, deafness, blindness, astasia-abasia, gross, stable stigmas	50	63	"

\*Illness is defined as patient complaints of poor health and reduced adaptation and working ability.

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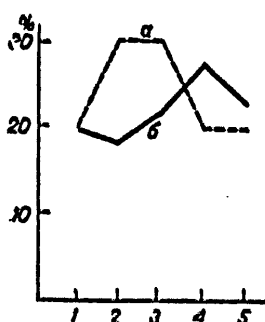
Table 3.

19	Attacks of dizziness	30	61	0.01
20	Hysterical traits in status (tendency toward exaggeration, demands for greater attention, unconcealed egoism, inconstancy and contradictory nature of judgments, emotional logic, traits of puerilism and pseudodementia)	32	46	Insignif.
21	Excitable traits in status (pettiness, straightforwardness, rancorousness, propensity for conflict, inclination toward importunity, sluggishness)	29	80	0.001
22	Hyposocial traits in status (familiarity, absence of reaction or ironic reaction to remarks of medical personnel, insistence on privileges)	16	51	0.001
23	Diffuse depersonalization phenomena (heavy, "cloudy," "unclear" head, "as if it was not my own")	19	21	Insignif.
24	Attacks of loss of consciousness	7	39	0.001

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Figure 1. Errors in Classification Depending on Complexity of Model: *a*--% errors in neurosis classification for the corresponding taxon, *b*--% errors in psychopathy classification for the corresponding taxon; abscissa--complexity of model (number of taxons); ordinate--magnitude of classification error (%)



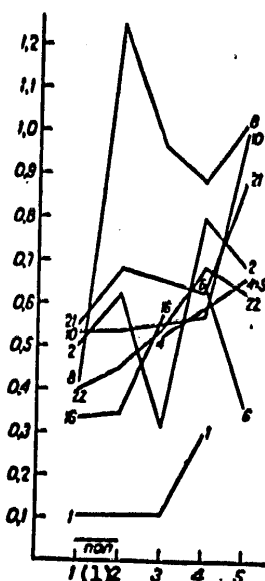
(and the correlation of the other signs among themselves) is low. But the correlation of the sign "incomplete family" with the other signs is the most complex, and it begins to manifest itself only when particular correlations are inspected ( $r_{8,10,2} = 0.1$ ,  $r_{16,21,2} = 0.15$ ,  $r_{21,22,2} = 0.2$ ; for index numbers pertaining to the curves, see Table 3). It was demonstrated that the percent juveniles suffering pathological personality development increases in incomplete families (14).

On analyzing observations wrongly classified as neuroses, the observation diagnosed as neurotic depression was invariably excluded from this class in all five models.

On analyzing observations wrongly classified as psychopathies, four observations were constantly excluded from all five models: In three of the observations unique features of the character were noted since childhood on the background of psychasthenia and they revealed themselves rather dramatically in asthenic disturbances. In one observation the manifestations of psychopathy arose in the form of asthenodepressive syndrome as a psychogenic reaction to the mental illness of a son. Persistence of an insoluble situation promoted subsequent pathological alteration of the character.

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Figure 2. Information significance of signs Depending on Model Complexity; Ordinate--in arbitrary units of information distances (information significance) of signs; abscissa --model complexity (number of taxons); index numbers on curves correspond to those in Table 3.



Key: 1. Sex

Fifteen signs were found to be significant in the fifth model (five taxons). Of these, eight were also significant in the first four models. These included "incomplete family" (see Table 3), neurotic symptoms (enuresis, and so on) and excitable traits in childhood, hysterical traits of character, and duration of illness; dysthymia, hysterical symptoms; excitable traits; hyposocial and diffuse depersonalization disturbances in the clinical pattern.

Thus the most constant of the dominant informative signs are not genetic (sex, heredity) but clinical and situational, as well as signs produced predominantly by the influence of microsocial conditions (hyposocial traits).

This research demonstrates the possibility for computer differential diagnosis of neurotic and psychopathic states. It permits the suggestion that situational microsocial influences, predominantly those occurring

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in childhood, lie at the basis of clinical differences between neuroses and psychopathies. Tranquillizer treatment reduces the degree to which clinical differences between neurotic and psychopathic states are expressed.

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PSYCHIATRY

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MUTUAL RELATIONSHIPS BETWEEN PHYSICIAN AND PATIENT AND THEIR INFLUENCE ON PSYCHOTHERAPY OF NEUROTIC PATIENTS

Moscow ZHURNAL NEVROPATOLOGII I PSIKHIATRII in Russian No 11, 1978  
pp 1710-1715

[Article by V. A. Tashlykov, Department of Neuroses and Psychotherapy, Leningrad Scientific Research Psychoneurological Institute imeni V. M. Bekhterev]

[Text] One of the most pressing problems of neurosis therapy is that of studying the conditions promoting optimum, effective psychotherapy, a significant psychological characteristic of which is the mutual relationship between the physician and the patient.

Many authors have concluded psychotherapeutic contact to be an important therapeutic factor that often predetermines the success of psychotherapy. (1-3). Development of scientific ideas concerning the therapeutic significance of mutual relationships between physician and patient has proceeded in parallel with evolution of psychotherapy as a method of a physician's mental influence upon the patient. Representatives of different areas of domestic medicine have always devoted serious attention in their work mainly to the deontological aspects of the physician's behavior in therapy (4-7).

The authors of most foreign works on the physician-patient relationship problem traditionally concentrate their attention mainly on the unique personality features of the patient and his reactions to the physician (8-10). As Freud's hypothesis concerning a patient's "transfer" of his Oedipus complex to the physician evolved, psychoanalysts came to recognize the social aspect of communication between patient and physician, and the traditional psychoanalytical premise of a physician's passiveness and nonparticipation was rejected. But the essence of the problem continued to be viewed as before. Scales and questionnaires are set up for experimental research on physician-patient relationships and the obtained material is interpreted in many foreign works on the basis of psychoanalytical premises, and thus they reflect shortcomings inherent to psychoanalysis (11-13).

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In Soviet psychotherapy, contact between physician and patient is interpreted as a unique form of social communication based mainly on relationships of trust (2-3). When an experimental psychological approach is taken to this problem, this interpretation of psychotherapeutic contact requires the use of the categories of social psychology, to include set, standard, role behavior, and empathic communication within the diadic type of communication (14,15).

The goal of the present work was to subject, to clinical-psychological and experimental-psychological analysis, the unique features behind formation of psychotherapeutic contact between physician and patient, and its influence on the effectiveness of psychotherapy and its optimum in the treatment of neuroses. A special experimental psychological technique was developed for this research (16). Directed interview and a physician selection technique based on photographs of persons of different sex and age were employed to study the initial sets of the patients in relation to the physician and the forthcoming treatment. The features of mutual perception of the physician and patient were revealed by means of a technique arbitrarily called the "scoring technique" (selection and ranking, on the basis of significance, of 10 traits from a set of 54 qualities characterizing the personality). This technique can also be used to obtain the characteristics of significant persons within the patient's immediate surroundings (father, mother, friend, supervisor at work, colleague, and so on) and of his standard ideas about these people. By comparing these characteristics with the physician standard we can reveal the genesis of the image of the "ideal" physician. Comparable variants of questionnaires and interviews, different ones for the physician and the patient, were used to reveal the patient's and physician's evaluations of the psychotherapeutic process, the dynamics of their relationships, and their degree of satisfaction with the contact and with the results of treatment.

The object of study consisted of 100 patients, 80 with neuroses and 20 with psychopathies of the psychogenic decompensation degree. There were 46 men and 54 women; 53 patients were 35 years old or less, and 47 were over 35; 58 had a higher education, and 42 persons had a secondary education. The subjects distributed themselves in the following way in relation to the forms of their illness: Neurasthenia was diagnosed in 33 patients, hysteria was diagnosed in 37, neuroses involving obsessive states were diagnosed in 10, and psychopathy was diagnosed in 20. The principal clinical syndromes accompanying the neuroses were anxious-phobic (45 cases), which dominated in the group of neurotics suffering obsessive states and hysteria, and the asthenic syndrome (24), which was observed most frequently among neurasthenic and hypochondriacal patients (11 patients).

The treating physicians that analyzed these patients included 11 psychotherapists from the department of neuroses and psychotherapy of the Institute imeni V. M. Bekhterev.

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The attitudes of the patients to the physician and treatment prior to meeting the treating physician were studied in the first stage of the research. Every patient has a certain image of the "ideal" physician that could satisfy his need for help and for communication of a certain nature. Descriptions of the photographs were quantified by the content analysis method (17). All patients noted, in their images of the "ideal" physician, first of all the personality properties which reflect an emotional relationship of the physician to the patient. The domination of characteristics typical of an empathic relationship of the physician to the patient permitted definition of the emotional type of physician standard as "empathic." When the degree to which this characteristic is expressed was moderate, the physician standard was arbitrarily designated as "emotionally neutral." Presence or absence of volitional qualities in the physician and statements by patients concerning the leading role of the physician in contact supplemented the description of the "ideal" physician by two variants, arbitrarily named "directive" and "nondirective."

The "empathic" type of physician standard was chosen most frequently by hysterical patients (81 percent). This choice may be associated with the greater need hysterical patients have for understanding and recognition from surrounding individuals. The "empathic," "directive" variant was preferred by neurotic patients with obsessive states (70 percent). The reason for this choice lay in the fact that the patients needed guidance. It reflected the hope of surmounting indecisiveness with the help of the physician's benevolent and strong personality. The "emotionally neutral" type of physician was selected more frequently by neurasthenic patients (54 percent) owing to their greater need for acquiring the quality of self-control.

The physician standards selected by the patients were compared with the characteristics of other real persons with the goal of determining which of the images of people coming in contact with the patient comes close to the physician standard. It was established that for most patients this standard is comparable with descriptions of some of those persons who are most authoritative in relation to the patient (mother, teacher, and so on). Analysis of the standards of persons coming closest to the physician standard permitted examination of the role played by the "ideal" physician and distinguish two variants of his role--that of a guide, which was chosen by 63 percent of the patients, and that of a partner.

The image of the physician is associated to a certain degree with the patient's set for the forthcoming treatment. Patients expecting meticulous examination, a precise diagnostic conclusion, explanation, and training in the ways to surmount the illness were predominately oriented toward the "emotionally neutral" physician. As was noted earlier, this type of set occurred mostly among neurasthenic patients. Patients with a set for sympathy, understanding, and support in resolving a pathogenic situation preferred the "empathic" physician. This choice of contact

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was usually encountered among hysterical patients. Patients expecting a "magic cure" through hypnosis or new medicines needed a guide-physician. This set reflected the patient's passive position and occurred most frequently among patients with the hypochondriacal syndrome.

The next stage of analysis was to study the unique features of the way the physician and patient perceive one another, and the influences perception has on formation of psychotherapeutic contact. The "emotionally neutral" variant dominated over "empathic" in the descriptions given by the patients of the real treating physicians, in contrast to the corresponding relationships seen in the standard ideas about the physician. The "directive" variant of the physician description was indicated by the patients more frequently than the "nondirective" variant. On the whole the patients perceived the treating physician equally often in the role of a guide and a partner. It should be noted that female patients described the treating physician as "empathic" three times more frequently than did men. Neurasthenic patients called their physician an "emotionally neutral, non-directive" partner most frequently. Hysterical patients evaluated the treating physician as a "directive" guide more frequently (52 percent) than did neurasthenic patients (30 percent). All neurotic patients suffering obsessive states evaluated their treating physicians during communication with them as possessing certain volitional qualities.

The distribution of role evaluations (partner and guided) was relatively uniform in the descriptions of the physician-patient relationships, with guided patients dominating slightly. It should be noted that in most descriptions of such patients, the physicians noted traits of indecisiveness, lack of confidence, and passiveness.

The obtained data on the specific ways physicians and patients perceive one another and an analysis of the questionnaire and interview data made it possible to reveal three dominant types of psychotherapeutic interaction between physician and patient in psychotherapy.

The first type of contact is psychotherapeutic guidance (45 percent), in which the physician occupied the dominant, active position and the patient remained relatively inactive. Often endowing the physician with "magic" qualities, the patients were especially susceptible to his suggestive influences. It should be noted that this type of contact reflects the traditional sociomedical conception of roles in the physician-patient diad (a passive, helpless patient and a physician appearing as a source of strength and help). Among the clinical groups, this type of contact dominated for psychopathic patients (55 percent) as well as neurotic patients exhibiting the asthenic syndrome (50 percent); it was rarely encountered among neurotic patients with obsessive states (20 percent). In a number of cases, when the motivation for treatment was weak, the set was passive, intelligence was low, and the personality of the patient was characterized by relative social immaturity, the patient

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needed guidance and authoritative counsel, and this type of contact was necessary and effective. Psychotherapeutic guidance coupled with an empathic approach permits these patients to assimilate the physician's premises better and thus develop adequate sets and forms of behavior. Low psychotherapeutic activity of the patient, and frequently dependence on the physician for completion of treatment, was a shortcoming of this type of contact.

The second type of interaction between physician and patient established from analyzing the material was psychotherapeutic partnership (38 percent), which was typified by the physician's desire to develop the patient's activity and his responsibility for the outcome of treatment from the very beginning. This type of contact dominated among neurotics with obsessive states (60 percent). Its advantages lie in presence of sufficiently deep contact between the physician and patient, and in the psychotherapeutic activeness of the latter.

The third type of interaction between physician and patient is psychotherapeutic guidance-partnership (17 percent), in which the initial role behavior of both individuals changed in the course of psychotherapy. In this case the type of interaction between physician and patient usually changed in the direction from guidance to partnership owing to the fact that the patient became an active participant of the psychotherapeutic process. This type of contact was most widespread among neurasthenic patients (24 percent). Its advantage lay in successive development of the patient's psychotherapeutic activeness.

The therapeutic suitability of mutual relationships evolving between physician and patient in the process of psychotherapy was evaluated with the help of a rating scale of optimum contact developed specially on the basis of an analysis of questionnaire and interview data.

The first characteristic of the degree to which contact was optimum was the extent to which the patient "accepted" the emotional and role behavior of the physician, with a consideration for the patient's standard of the physician. It was established that the initial image of the "ideal" physician often changed in response to contact with the treating physician, both in the direction of closer agreement of the treating physician and the image (22 percent) and in the direction of greater distance (11 percent). An analysis of the data demonstrated that when the physician is aware of and accounts for the patient's physician standard, he can doubtlessly establish closer contact. When the opposite is true, communication does not develop properly. Often the patient "accepted" the inconsistency between the physician's role behavior and that expected of him, but he was unable to "accept" the emotional discrepancies. A high degree of "acceptance" of the physician's style of behavior by the patient was observed more frequently in the presence of partnership involving "empathic" relationships (100 percent) than in the presence of guidance coupled with

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"emotionally neutral" relationships (29 percent). A low degree of "acceptance" was encountered more often among hysterical patients (24 percent) than among neurasthenic patients (12 percent). The reason for this lies in the fact that most hysterical patients typically had a set for the "empathic" type of communication, and as a rule the physician's "emotionally neutral" attitude elicited a negative reaction in these patients.

The second characteristic of the degree to which contact is optimum is the extent of the patient's "acceptance" of the psychotherapeutic objectives of the physician, which not infrequently failed to agree with the patient's expectations from the treatment. The physician's ignorance of certain stable therapeutic expectations of the patient or his failure to account for them led to tension, to a struggle to confirm therapeutic goals (as an example, one physician focused on analyzing the causes for the inadequacy of the patient's set, and all the patient expected of the physician was intervention into pathogenic family or production situations). In a number of cases this tension is surmounted by partial acceptance, in the initial phase of therapy by the physician, of some of the expectations of the patient (for example his set for medicines, hypnosis, or autogenic training), followed by reorientation of the patient in accordance with the previously defined psychotherapeutic objectives. Strong expression of this characteristic was encountered most frequently with contact of the guidance-partnership type (82 percent). Successive development of the patient's activeness in the presence of this variant of contact promoted successful development of compatibility of the physician's objectives and the patient's expectations. A high degree of "acceptance" of the physician's objectives was most pronounced among neurotics suffering obsessive states (60 percent) and least of all among patients with the hypochondriacal syndrome (9 percent). This can be explained by the fact that neurotics suffering obsessive states sense the "strangeness" of their disease especially acutely and eagerly accept the psychological objectives of psychotherapy.

The third characteristic of the degree to which contact was optimum was the extent of the patient's psychotherapeutic activeness during therapy; his activeness varied between resistance to psychotherapy and active cooperation. Resistance was usually manifested as the patient's displeasure with the physician, dissatisfaction with the therapy, negative reactions to certain demands of the physician, and so on. An analysis of interview data showed that the most frequent causes of this were "incompatibility" of the patient's sets and the physician's psychotherapeutic style of behavior, the physician's obvious disregard of the patient's stable therapeutic expectations, premature explanation of the causes of the neurosis, demands of frankness or activeness imposed upon the patient too soon, the physician's latent negative emotional reaction to the patient, and transfer of the patient to another physician without adequate preparation. The high and moderate degrees of patient activeness

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were found to occur most frequently (100 percent) in the presence of partnership and guidance-partnership containing "empathic" relationships. A high degree of this characteristic was more typical of neurasthenic patients (22 percent) than hysterical patients (5 percent), and a low degree of activeness was noted most frequently among patients with the hypochondriacal syndrome (73 percent).

When contact was evaluated by all three characteristics together, highly optimum contact was encountered most often in "empathic" partnership (86 percent) and guidance-partnership (82 percent), and much more rarely in "emotionally neutral" guidance (7 percent); rather high and moderate degrees of optimum were usually encountered among neurasthenic patients and neurotics suffering obsessive states, while the lowest degree was observed among hysterical patients. The most effective types of contact in the presence of neurasthenia were partnership and guidance-partnership, partnership and guidance were equally effective in the presence of hysteria, partnership was most effective in the presence of neurosis coupled with obsessive states, and guidance was the most effective in relation to psychopathies.

Data on the effectiveness of psychotherapy reflected the physician's and patient's evaluation of the work done and of the results of their cooperation. A specially developed scale was used in the analysis of the data. One of the principal characteristics of the effectiveness of psychotherapy was the score given to the direct results of treatment (improvement in symptoms). A high score--significant improvement (recovery)--was found to appear most frequently with "empathic" partnership (57 percent), and the lowest score--insignificant improvement (no change)--accompanied "emotionally neutral" partnership (61 percent). The best therapeutic impact was enjoyed by neurasthenic patients, while that of hysterical patients and neurotics with obsessive states was relatively worse.

A number of additional criteria of the effectiveness of psychotherapy were studied with the goal of reflecting some aspects of the psychotherapy. These included, first, the degree to which the patient recognizes the psychological mechanisms of his illness (a high degree of awareness was found to be the most widespread with "empathic" partnership and, in relation to clinical groups, among neurotics with obsessive states; a low degree of awareness correlated with "emotionally neutral" guidance and psychopathies); second, the degree to which adequacy in relation to the disease, to the patient's personality, and to surrounding individuals was increased. Dominance of a high degree of expressiveness of this index in the case of the "empathic" guidance type of contact can be explained by the fact that it was in this form of contact that acceptance of the physician's premises by the patient was observed most frequently. A large increase in adequacy was usually noted among neurotic patients with obsessive states. Emotional reactions of the patient (confidence, unstable confidence, anxiety) to release from the clinic were also studied.

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A sense of confidence was usually observed in relation to "empathic" partnership (43 percent), while a sense of anxiety was noted usually with "emotionally neutral" partnership (57 percent). Anxiety was noted least often with "empathic" guidance-partnership (9 percent), due not only to improvement of condition but also development of a certain independence of the patient from the physician during psychotherapy.

The overall evaluation of the effectiveness of psychotherapy reflected the productivity of contact between physician and patient. "Empathic" partnership (43 percent) and "empathic" guidance (41 percent) were most effective, while "emotionally neutral" guidance was the least effective (61 percent). It should be noted that in contrast to the situation with other forms of contact, in the presence of "empathic" guidance-partnership a low degree of psychotherapeutic effectiveness was not noted in any of the observations. This provides the grounds for suggesting that in addition to "empathic" partnership, this form of psychotherapeutic interaction is the most productive.

Thus the treating physician's awareness and consideration of what the neurotic patient expects from him and the forthcoming treatment, and of the unique features of their "compatibility, and maintenance of control over both the physician's own emotional reactions and those of the patient are important to formation of the appropriate type of interaction, to heightening the frankness and trustfulness of the contact, and to surmounting the resistance of patients--that is, they are important to optimum organization of psychotherapy, and thus to heightening the effectiveness of psychotherapy.

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PSYCHOLOGY

LOMOV VIEWS FUTURE OF SOVIET PSYCHOLOGY

Moscow BUDUSHCHIYE NAUKI in Russian 1978 signed to press 2 Mar 78 pp 254-265

[Article by B. F. Lomov, Psychologist, USSR Academy of Sciences and USSR Academy of Pedagogical Sciences Corresponding Member, Director, USSR Academy of Sciences Institute of Psychology, President, USSR Society of Psychologists in the Book "Budushchiye Nauki" (The Future of Science) edited by Ye. B. Etingof: "The Horizons of Soviet Psychological Science"]

[Text] The significance of psychological science is continuously growing in the system of modern scientific knowledge. Being the main area of science studying man, psychology is now participating in the solution of many problems, both fundamental and applied, arising in the practice of communist construction.

Tasks requiring psychological competency are arising in fact in all spheres of the society's life--in production and management, in education and public health, in ideology and propaganda, and in science and art.

This is why the role of the human factor in all of the spheres enumerated above is growing. By the human factor I imply the broad range of psychological, psychosocial, physiological, and other properties possessed by living people, and which one way or another manifest themselves in their concrete activity, having an influence on the quality and effectiveness of this activity. I am implying, first of all, the individual's capabilities and needs, the motives of his behavior, his interests and creative capabilities, his efficiency, working ability, intelligence, emotions, will, character, consciousness, self-awareness, social sets, value orientations, and so on.

In developed socialist society the role of these factors grows immeasurably in comparison with their role in preceding socioeconomic formations.

The range of problems pertaining to the human factor is extremely broad. Some of them are purely psychological while others require the competency of social, natural, and technical sciences contiguous with psychology. But in both cases solution of these problems would be impossible without reliance upon the data of psychological science.

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The study of human factors in various spheres of the life of socialist society and the use of the corresponding knowledge (including mainly the laws governing human mental activity) in social practice are now becoming the most important prerequisites for solving many problems arising in the course of communist construction. As CC CPSU General Secretary Comrade L. I. Brezhnev noted at a jubilee assembly dedicated to the 250th anniversary of the USSR Academy of Sciences, "Science must also more actively promote development of society's main productive force--development of man himself, his capabilities and endowments, and it must increase his benefit to society."\*

As with other areas of science, in developed socialist society psychology is placed fully in the service of the working man. This is precisely where it discerns its most noble goal. The USSR Constitution declares: "In accordance with the communist ideal 'Unrestrained development of each is the prerequisite of unrestrained development of all,' the state takes as its goal expansion of the real possibilities citizens have for utilizing their creative strengths, capabilities, and endowments, for comprehensive development of the personality."\*\*

What are the principal directions in research on the human factor, and which directions define the functions of psychological science in developed socialist society?

It was emphasized at the 25th CPSU Congress that if the economic and social tasks facing the country are to be completed successfully, we can follow no path other than rapid growth of labor productivity and of the effectiveness of all social production.

Of course, before we can reveal the reserves for growth in labor productivity we would have to initiate research in many areas of the social, natural, and technical sciences. Achievements in the area of production economic planning and control systems and the progress enjoyed in development of engineering and technology are uncovering huge reserves for increasing labor productivity and the effectiveness of production. But these reserves could be utilized fully only on the condition that the individual's creativity is allowed to develop. There is no need to prove that man is the main productive force of society. And this means that the sciences studying man--that is, those physical and spiritual capabilities "which are possessed by the organism, the living personality of man, and which are

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\* Brezhnev, L. I., "Gordost' otechestvennoy nauki. Rech' na torzhestvennom zasedanii v Kremlevskom Dvortse s"yezdov, posvyashchennom 250-letnemu yubileyu Akademii nauk SSSR. 7 oktyabrya 1975 goda" (The Pride of Domestic Science. Speech at a Solemn Assembly in the Kremlin Palace of Congresses Dedicated to the 250th Anniversary of the USSR Academy of Sciences. 7 October 1975), Moscow, Politizdat, 1975, p 11.

\*\* Konstitutsiya (Osnovnoy Zakon) Soyuza Sovetskikh Sotsialisticheskikh Respublik" (The Constitution (Fundamental Law) of the Union of Soviet Socialist Republics), pp 11-12.

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put into play by him whenever he produces any sort of consumer valuables"\*- have the most important place in revealing the reserves for growth in labor productivity.

Research on these capabilities (in the broad sense of the word) and on the laws and conditions of their development and implementation in labor could hardly be possible without the active participation of psychological science. Psychology faces a broad range of problems in this regard--from psycho-physiological to psychosocial problems. Sensible--that is, scientifically grounded--organization of labor requires research on the way the individual's capabilities, needs, and the motives of his behavior develop, the way working knowledge and skills, the ability to plan one's work, proficiency, and labor excellence are molded, on the dynamics of efficiency, on the way individual psychological features of the individual affect his labor, the way the labor collective forms and develops, the way the psychological climate takes shape in the shop, section, and enterprise, and much else.

We must focus special attention on coordinating technology and production processes with human characteristics, inasmuch as the effectiveness and dependability with which equipment is operated depends on this to a significant extent.

It should be emphasized that at the present stage of production development, the nature of social labor is changing fundamentally. The principal changes are occurring in the ratio between physical and mental labor. Full mechanization and automation of production processes and the use of computers to control them have become typical phenomena of modern production. Under these conditions the complexity of human activity is increasing: The significance of actions associated with the use and processing of information and decision making is increasing; the simplest forms of operations are decreasing in number and undergoing modification, and physical loads are decreasing. Requirements on man's "intellectual sphere," on his volitional and emotional qualities are growing. The responsibilities of specialists controlling automated systems are rising significantly: Their errors can on occasion lead to disaster. We should add to this that the swift growth of the educational, cultural, and political competency of Soviet people coupled with the standard of living they have achieved has heightened the significance of social and psychosocial factors in their productive activities.

All of these trends have had the result that psychological factors have become the most important reserve for growth in labor productivity, and that scientific research on these factors has become a task of great state importance.

Utilization of the recommendations offered by psychological science concerning production organization can and does in fact provide a significant technical-economic impact. We can cite many concrete examples in this

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\*Marks, K., and Engel's, F., "Soch." (Works), Vol 23, p 178

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regard. But of course the technical-economic impact enjoyed from introducing the recommendations of psychology into production is not all that is important. What is even more important is that psychologically grounded improvement of work processes is promoting development of man's capabilities and maintenance of his efficiency. Such improvement is also an important prerequisite for transforming labor into the primal vital need of the individual.

Of course psychological research on human labor is also being conducted in capitalist countries with the goal increasing labor productivity (in this case the research is often more effective than in our country in relation to some production operations). In the end, however, the results of this research are utilized in behalf of capital. In the West, psychology is often the means for exploiting laborers even more.

In our country, where exploitation of one man by another has been abolished, psychology serves the interests of the people of labor. The results of applying its recommendations to production benefit all society and every Soviet citizen.

Psychological research has no less significance to the matter of improving national economic control systems. After all, control means, first of all, management of people. If it is to be organized on a scientific basis, we must gain an understanding of the laws governing human behavior and development of the personality's psychological makeup, of the individual psychological differences between people, of the processes of communication between them, of formation of interpersonal relationships typical of socialism, and so on. Understatement of the psychological aspects of particular control problems can lead (and does in fact lead) to the arising of various "psychological barriers." On the other hand wherever these aspects are considered, they become a powerful factor, promoting an increase in the effectiveness of control.

The range of psychological problems associated with the task of improving the national economic control system is also extremely broad. Solution of these problems is requiring the united effort of psychologists specializing in different areas. It would be important to emphasize that in developed socialist society, the broadest masses of laborers are encouraged to participate in management. This means that the role of psychological problems associated with communist indoctrination of Soviet people is growing.

The 25th CPSU Congress has defined the task of molding the new man as one of the most important in the present stage of communist construction. Its completion requires initiation of research in a number of sciences. Psychology, which must reveal the mechanisms behind the way the socialist social relationships are reflected in concrete people and behind the way the traits of their personalities are molded, has a major role among them. After all, it would be incorrect to believe that new social relationships would, so to speak, automatically produce a new man. This is a complex process,

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and our ability to control it will depend on what we learn about the laws governing development of the personality. Social relationships are not something existing outside of concrete individuals. Every person is included within these relationships, directly by his activity and through his communication with other people. He is both the subject and carrier of these relationships.

As he develops in society, the individual assimilates the evolved system of norms, principles, and rules of behavior. Most important in this regard are the psychological mechanisms behind the social regulation of behavior.

The issue of the new (more accurately, "modernized") man, who is contrasted with the "traditional" man in terms of his psychological characteristics, is being raised in bourgeois psychology. Painting the portrait of "modernized" man, researchers point to unification of psychological makeup, to standardization as one of the principal characteristics. It is asserted that the relationships "modernized" man has with other people are structured in accordance with the principle behind man-machine relationships. In this case attempts are being made to deduce this portrait directly from the specific features of the scientific-technical revolution examined without regard to the social system in which they exist.

In its research on molding of the new man, Soviet psychology bases itself on an analysis of social relationships. They (and not development of production and equipment itself) are precisely what predetermine the properties of the new man. In opposition to the conception of the "modernized" man, Soviet psychology is working on the theory of comprehensive development of the entire personality of the individual in socialist society. Organic unification of the achievements of the scientific-technical revolution with the advantages of socialism is not leading to unification and standardization of people; on the contrary it is creating the possibilities for all-out development of every individual, of the individuality of every person.

It would be important to note that the ideological function of psychology is growing today. The question as to what man is, what the "mainsprings" of his behavior are, is not of purely academic interest alone. The problem of man is now becoming the field of the most acute ideological struggle. It is well known that the ruling circles of the Western countries are trying to capitalize upon some psychological conceptions to prove the stability of the capitalist structure (supposedly its stability goes hand in hand with the very nature of man), for the purposes of racial discrimination (as if nature itself has differentiated the races into superior and inferior), to fight the movement of national liberation (by their psychological makeup some nations are capable of self-government while others are not), and so on.

Take as an example conceptions asserting presence of genetic limitations upon the mental development of certain categories of people--classes, nationalities, and races. The practice of socialist and communist construction in countries of the world socialist system has demonstrated in fact that

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the real limitations are created by class and other barriers, and not by human genetics. The socialist system has broken these barriers down, opening a broad highway for development of every individual.

Implementation of the principles of social equality and internationalism has demonstrated the groundlessness of conceptions asserting that talent is the property of the elite, which is supposedly placed above the masses by nature itself.

The practice of revolutionary transformation has also refuted the Freudian thesis of primeval antagonism between the personality and the society, as well as the assertion made by some psychologists that egoism is a natural property of man, the product of the biological principle of the struggle for existence.

The experience of building a new society in our country and in other socialist countries has confirmed Marx' premise that only within the collective can the individual acquire the resources affording him the possibility for comprehensive development of his inherited capabilities and, consequently, that it is only within the collective that personal freedom is possible. Development of the instinct of collectivism in the mutual relationships of people has demonstrated that egoism is a social and not a biological phenomenon.

The results of psychological research are being used by capitalist ideologists to develop the "technology" of influencing the consciousness, the "technique of imprinting the brain" with ideas favoring the capitalist way of life as supposedly being the human ideal--that is, psychology is being used as a means of ideological brainwashing of people in the interests of capitalism.

Under these conditions further work on psychological theory based on the Marxist-Leninist doctrine of man is acquiring extremely great significance in the struggle for the ideals of socialism. Only a consistently scientific theory revealing the essence of man as representing the entire system of social relationships can oppose the pressure of Freudian and neo-Freudian, behavioristic and neobehavioristic, biologizational, positivistic, and other conceptions widely encountered in the West.

The achievements of Soviet psychology can and must be utilized in the interests of asserting the socialist way of life, in the interests of socialism's ideology.

Thus psychology is directly involved in the problems of communist construction. Utilization of its achievements in social practice is becoming the most important prerequisite for growth in labor productivity and quality, greater effectiveness of production and control, development of modern technology and production processes, improvement of socialist social relationships, and the molding of the new man. Here lie the basic functions of

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psychological science in developed socialist society. Performing these functions, psychology is consistently following the principles of true humanitarianism and social optimism.

In connection with constantly increasing differentiation (there are several dozen independent areas and directions in modern psychology), the philosophical, methodological, and general theoretical problems of psychology are acquiring exceptionally great significance in the present stage of our science's development. Only intense work on the general theory of psychology will insure careful selection and systematization of scientific data, ideas, approaches, methods, and conceptions being accumulated in every specialized area and, consequently, development of psychological knowledge as a whole. Fundamental research is precisely what is defining the prospects for the development of our science. At the same time development of the general theory of psychology is a prerequisite for effective utilization of its achievements in social practice.

Developing on the basis of Marxism-Leninism, Soviet psychology has always devoted and continues to devote a good deal of attention to general theoretical problems. Its methodological premises, which were defined about half a century ago, are enjoying constant development, improvement, and enrichment.

Work on the principles of determinism, development, reflection, the unity of activity and consciousness, and the personality approach in application to the entire complex of psychological problems has produced the main achievements of Soviet psychology.

In addition to general psychology, fundamental research in its special areas has great significance to the development of psychological science--social, medical, child and pedagogical, engineering psychology, labor psychology, neuropsychology, general and differential psychophysiology, psycholinguistics, sports psychology, management psychology, and other areas. It should be noted in this regard that some of the directions of psychology (engineering, organizational, space psychology, and so on) have been brought into being by the scientific-technical revolution.

Each of the enumerated areas of psychology deals with certain facets of mental phenomena, provides knowledge about their associations and relationships, and helps us to penetrate more deeply into their nature. At the same time development of the special areas of psychological science is creating a broad foundation for development of its fundamental problems and its general theory. While a quarter of a century ago general psychology was "nourished" by concrete data accumulated mainly in child and pedagogical psychology, today the range of these data is expanding significantly and growing richer. This, by the way, is very important to theoretical generalizations, and to their control and correction.

Theoretical generalizations in psychology now require increasingly deeper analysis and comparison of data accumulated in different areas. But these

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data are often found to be contradictory, and they often fail to fit into the "procrustean bed" of the general schemes and conceptions to which we have become accustomed. Unfortunately we clearly devote insufficient attention to systematizing data being accumulated in different areas of psychological science.

Development of a general theory of psychology which would be structured on the basis of the achievements of the entire system of psychological sciences is urgently requiring work on concrete scientific principles and methods of systems analysis, which rests upon the premises of dialectic materialism and which is confirmed by the entire course of the development of modern science.

The idea of the systems approach is now attracting more and more attention from psychologists. There have already been some achievements in this area. Work on a systems theory of psychology is the main theoretical task of the newly created USSR Academy of Sciences Institute of Psychology.

The "theoretical edifice" is itself a complex structure. It would be incorrect to interpret the entire problem as if general theory is a set of general ideas and principles located in a single plane. In modern psychology, theory falls into different levels. Some of them pertain to the most general laws and properties of psychology, others are related to special areas of human activity, a third group deal with particular problems, and so on. We can obviously consider macro-, meso-, and microlevels of analysis of mental phenomena and, correspondingly, different levels of theoretical generalizations. The relationship between different levels is rarely obvious. Sometimes in psychological research we encounter attempts at excessive expansion or, on the other hand, unjustified constriction (this occurs much more rarely) of the spheres of application of particular generalizations, conceptions, and hypotheses, and we occasionally come across inaccurate evaluations of the level of description, of "materialization" of psychological knowledge. This creates theoretical confusion, and practical utilization of the results of such a theory can lead to serious errors.

The present stage of development of psychology urgently demands analysis of the "architectonics" of its theoretical edifice, revelation of those "blocks" and "stories" which have already been created, of those which are presently only on the drawing boards, and of those which must still be planned and created.

As I noted earlier, within the system of modern scientific knowledge psychology is beginning to play an increasingly more noticeable role. The specific place of psychology within the system of science--it is the dominant science in research on man--opens up broad perspectives for its development. Comrade L. I. Brezhnev said: "The new possibilities for fruitful research of both general theoretical, fundamental, and applied nature are being opened up at the juncture of different sciences, particularly

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the natural and social sciences. These possibilities must be utilized to the fullest extent."\* This pertains to psychology perhaps more than to any other science. We can be sure that utilization of the possibilities being opened up by the specific place of psychology will insure its intensive development.

Modern psychology is a highly differentiated system of scientific disciplines and directions. Some of them (for example child and pedagogical psychology) already have long-established traditions; their object and problems have been clearly defined, and the research methods have been worked out. Others are in a developmental stage (social psychology for example). A third group are just beginning their development (for example forensic, organizational, and space psychology). A fourth group are enjoying almost no development at all (for example the frontiers of psychology and genetics, psychology and biochemistry, and psychology and economics). Once our country had conducted a great deal of research in zoopsychology and comparative psychology. Unfortunately this research has been scrapped.

Thus there are obvious disproportions in the development of different areas of psychological science. In the next few years we will have to begin work on those areas of psychology which are still in an embryonic state. Inasmuch as these areas are for the most part on the frontiers of other sciences, their development will require the closest possible cooperation with contiguous sciences.

Certain disproportions can also exist in the analysis of the problems of general psychology. While in regard to problems pertaining to so-called cognitive processes we are working on a broad front and many valuable achievements have been attained, research on the processes of mental regulation of behavior and activity is still clearly insufficient. Very little research is being done on attention, emotion, will, and character. Not enough emphasis is being placed on ideas and imagination. And yet within the overall system of psychological knowledge these problems have extremely great significance. We must apparently redistribute our efforts: We must plan our work in such a way as to insure more or less harmonious development of the entire system of the basic problems of general psychology.

Jointly with the USSR Academy of Sciences Institute of Psychology, the USSR Academy of Pedagogical Sciences, and the country's leading universities the USSR Society of Psychologists has undertaken an effort to write a plan for development of psychology in our country. This work must be continued. We must come up with a long-range plan which would insure a rise in the effectiveness and quality of psychological research.

The time has come to seriously analyze the trends in development of the problems themselves with which psychology is concerned, to reveal the

\*"Materialy XXV s"yezda KPSS" (Proceedings of the 25th CPSU Congress), p 72

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logical relationships among these problems, to determine those areas of problems which require concentrated effort, and to organize work on them appropriately.

Further work on the conceptual machinery of psychological theory, especially on those categories reflecting the most general and significant properties of phenomena being studied by psychology, has the most important significance to development of psychological theory.

The activity category is enjoying the most intense research in our country.

Application of the Marxist teaching on human activity has played and continues to play an important role in development of both general psychology and its specialized areas. But we should note that the concept itself of "activity" is now being used so broadly that its meaning is becoming fuzzy, and its power of explanation is waning correspondingly. Frequently one meaning of this concept is substituted by another, creating confusion. Within the system of Marxist-Leninist theory, activity is interpreted as a sociohistoric category, and as such it is the object of a number of sciences--philosophy and sociology, economics and law, and history and pedagogics. We should note that psychological research on activity has stimulated research on it in other sciences to some extent. But the aspect of activity which can be studied by no science other than psychology is not always clearly defined by psychology itself.

In concrete psychological investigations, activity has been traditionally studied and is studied today as the activity of an individual, as individual activity. And yet in real life the activity of the individual is associated one way or another with the activity of other people. Thus arises the task of conducting psychological research on different forms of joint activity. Work in this direction is already beginning in social psychology, but other areas of psychological science are no less interested in this area. Apparently joint activity of people must be studied by integrated effort.

Often when we deal with categories such as consciousness, cognition, personality, communication, social relationships, and so on, the psychological aspects of the research are often substituted by philosophical, sociological, pedagogical, and ethical aspects, and vice versa. The need has arisen for examining these categories as a system and for clearly determining those aspects which must be studied by psychology, and by psychology alone. Understandably, this would require joint creative work on the part of representatives of other sciences, chiefly philosophers.

We also need further deep theoretical research on the principles of psychology. The fundamental principles of Soviet psychology are well known, and there is no need to repeat them here. At the moment it would be important to note that the relationships between these principles are not sufficiently clear as yet. Some principles are extremely general, pertaining essentially to all sciences (for example the principle of determinism), while others

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embrace several associated sciences, and still others are specific to psychology. To put it more briefly, the principles are not of equal ranks. We have yet to reveal their associations and relationships and formulate the system of principles precisely as a system.

One of the most important prerequisites for development of psychological theory is active participation in social practice. In psychological society we can still encounter the absurd and harmful opinion that practical work is menial, that practical work is for those who lack the talent for greater things. It would be pertinent to recall the words of B. M. Teplov, a psychologist and an active member of the RSFSR Academy of Pedagogical Sciences, who wrote the following in his brilliant article "The Mind of A Troop Commander": "Were we to establish degrees of difficulty and of the complexity of the requirements these difficulties impose on the mind, we would have to recognize that from the point of view of diversity and, sometimes, the internal contradiction of intellectual tasks as well as the rigidity of the conditions within which mental work must proceed, the highest forms of practical activity would have to be placed at the top of our scale."\*

We must mold a correct attitude (especially among the young) toward the relationship between theory and practice in the development of science. Only an organic unification of theory, experimentation, and practice can insure a rise in the effectiveness and quality of psychological research.

Discussing introduction of the achievements of psychology into practice, it would be important to note that the ways these achievements are introduced can be different. In some cases introduction can be direct, while in others achievements can be introduced through pedagogics, medicine, engineering developments, and so on. Their introduction demands integrated research relying upon systems theory.

It is becoming vitally necessary to train specialists capable of working on practical scientific tasks--pedagogical psychologists, medical psychologists, and engineering psychologists. In the next few years we must develop programs for training such specialists and clearly determine their functions, the range of their tasks, and the principles and methods of their completion. Of course this would require serious improvement of the entire system of psychologist training. Persons who receive a psychological education must not only know a great deal, but they must also know how to do a great deal. They must have a facility with modern theory and methods of scientific research and practical scientific work--methods which they could utilize not only in scientific research institutions but also in production, in the design office, in the clinic, in the school, and so on.

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\*Teplov, B. M., "Problemy individual'nykh razlichiy" (The Problems of Individual Differences), Moscow, Izd-vo APN RSFSR, 1961, p 225.

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To psychological science the next few years must become a period of its intensive development, a time of improvements in the quality of scientific theoretical and experimental studies, of intensification of its educational and ideological role in the life of Soviet society, of a harder struggle against influences foreign to Marxism, and of greater participation in the practice of communist construction.

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PUBLICATIONS

NEW BOOK DISCUSSES STABILIZATION OF MEASURING DEVICES

Moscow STABILIZATSIYA IZMERITEL'NYKH USTROYSTV NA KACHAYUSHCHEMSYA OSNOVANII (Stabilizing Measuring Devices on Swaying Bases) in Russian signed to press 23 Jun 78 pp 2-4

[Title page, annotation, and table of contents of book by S.S. Rivkin, Nauka -- Glavnaya Redaktsiya Fiziko-Matematicheskoy Literatury, 2,750 copies, 320 pages]

[Excerpts] Title Page

Author: S. S. Rivkin

Title: "Stabilizatsiya Izmeritel'nykh Ustroystv na Kachayushchemsya Osnovani" [Stabilizing Measuring Devices on Swaying Bases]

Place and Year of Publication: Moscow, 1978

Annotation:

This book sets forth the chief questions of the mechanics of systems to stabilize measuring devices, direction finders and the sensitive elements of navigation and control systems, on swaying bases. The investigation of stabilization systems for these instruments and solutions to applied problems are given with reference to a ship, but the material presented in the book is entirely applicable to measuring device stabilization systems installed in other mobile objects.

The main characteristics of the investigation of measuring device stabilization systems are the use of probability techniques, techniques from the theory of automatic regulation, and the methods of statistical optimization (Kolmogorov-Viner, Kalman, and others).

In addition to the theoretical presentation the book contains solutions to a large number of applied problems from the field of stabilizing measuring devices.

The book is intended for engineering-technical and scientific workers working with questions of stabilizing measuring devices, applied gyroscopy, and automatic control of moving objects. It can also be used by upper division and graduate students in the appropriate specializations.

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The book contains 11 tables, 100 illustrations, and 101 bibliography entries.

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PUBLICATIONS

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BREEDING SPRING WHEAT

Moscow SELEKTSIYA YAROVY PSHENITSY in Russian 1977 signed to press  
25 Jul 77 pp 2, 153-154

[Annotation and Table of Contents of book edited by N. V. Turbin,  
Izdatel'stvo "Kolos", 1910 copies, 154 pages]

[Text] The collection deals with the problems of breeding spring wheat, including short-stemmed varieties of the intensive type. The methodology is revealed for breeding spring wheat for drought-resistance and early ripening, and raising the quality of the grain. The biological characteristics of new regionalized and promising varieties are described.

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